ASME BOILER AND PRESSURE VESSEL CODE
AN AMERICAN NATIONAL STANDARD

(ACI STANDARD 359-86)

SECTION III

Rules for Construction of Nuclear Power Plant Components

SUBSECTION NCA

General Requirements for Division 1 and Division 2

1986 EDITION

JULY 1, 1986

ASME BOILER AND PRESSURE VESSEL COMMITTEE
SUBCOMMITTEE ON NUCLEAR POWER
ACI-ASME JOINT TECHNICAL COMMITTEE

THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS
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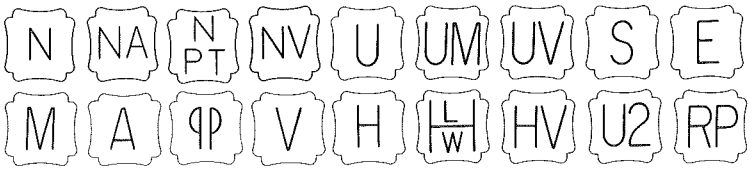

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1986 ASME
BOILER AND PRESSURE VESSEL CODE

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ADDENDA

Colored-sheet Addenda, which include additions and revisions to individual Sections of the Code, are published annually and will be sent automatically to purchasers of the applicable Sections up to the publication of the 1989 Code. The 1986 Code is available only in the loose-leaf format; accordingly, the Addenda will be issued in the loose-leaf, replacement-page format.

INTERPRETATIONS

ASME issues written replies to inquiries concerning interpretation of technical aspects of the Code. The Interpretations for each individual Section will be published separately and will be included as part of the update service to that Section. They will be issued semiannually (July and December) up to the publication of the 1989 Code. Interpretations of Section III, Divisions 1 and 2, will be included with the update service to Subsection NCA. Interpretations are not part of the Code or the Addenda.

CODE CASES

The Boiler and Pressure Vessel Committee meets regularly to consider proposed additions and revisions to the Code and to formulate Cases to clarify the intent of existing requirements or provide, when the need is urgent, rules for materials or constructions not covered by existing Code rules. Those Cases which have been adopted will appear in the appropriate 1986 Code Cases book: (1) Boilers and Pressure Vessels and (2) Nuclear Components. Supplements will be sent automatically to the purchasers of the Code Cases books up to the publication of the 1989 Code.

FOREWORD

The American Society of Mechanical Engineers set up a committee in 1911 for the purpose of formulating standard rules for the construction of steam boilers and other pressure vessels. This committee is now called the Boiler and Pressure Vessel Committee.

The Committee's function is to establish rules of safety governing the design, fabrication, and inspection during construction of boilers and pressure vessels, and to interpret these rules when questions arise regarding their intent. In formulating the rules, the Committee considers the needs of users, manufacturers, and inspectors of pressure vessels. The objective of the rules is to afford reasonably certain protection of life and property and to provide a margin for deterioration in service so as to give a reasonably long, safe period of usefulness. Advancements in design and material and the evidence of experience have been recognized.

The Boiler and Pressure Vessel Committee deals with the care and inspection of boilers and pressure vessels in service only to the extent of providing suggested rules of good practice as an aid to owners and their inspectors.

The rules established by the Committee are not to be interpreted as approving, recommending, or endorsing any proprietary or specific design or as limiting in any way the manufacturer's freedom to choose any method of design or any form of construction that conforms to the Code rules.

The Boiler and Pressure Vessel Committee meets regularly to consider revisions of the rules, new rules as dictated by technological development, Code Cases, and requests for interpretations. Requests for interpretation must be addressed to the Secretary in writing and must give full particulars in order to receive consideration and a written interpretation (see Mandatory Appendix covering preparation of technical inquiries). Proposed revisions to the Code resulting from inquiries will be presented to the Main Committee for appropriate action. The action of the Main Committee becomes effective only after confirmation by letter ballot of the Committee and approval by ASME.

Proposed revisions to the Code approved by the Committee are submitted to the American National Standards Institute and published in *Mechanical Engineering* to invite comments from all interested persons. After the allotted time for public review and final approval by ASME, revisions are published annually in Addenda to the Code.

Code Cases may be used in the construction of components to be stamped with the ASME Code symbol beginning with the date of their approval by ASME.

Code Editions may be used on or after the date of issue shown in the Edition. After Code revisions are approved by ASME, they may be used beginning with the date of issue shown on the Addenda.

Owners of nuclear power plants are cautioned that Code Editions, Addenda, and Cases to be used in construction shall be acceptable to the regulatory and enforcement authorities having jurisdiction at the nuclear power plant site.

Each state and municipality in the United States and each province in the Dominion of Canada that adopts or accepts one or more Sections of the Boiler and Pressure Vessel Code is invited to appoint a representative to act on the Conference Committee to the Boiler and Pressure Vessel Committee. Since the members of the Conference Committee are in active contact with the administration and enforcement of the rules, the requirements for inspection in this Code correspond with those in effect in their respective jurisdictions. The required qualifications for an Authorized Inspector or an Authorized Nuclear Inspector under these rules may be obtained from the administrative authority of any state, municipality, or province which has adopted these rules.

The Boiler and Pressure Vessel Committee in the formulation of its rules and in the establishment of maximum design and operating pressures considers materials, construction, method of fabrication, inspection, and safety devices. Permission may be granted to regulatory bodies and organizations publishing safety standards to use a complete Section of the Code by reference. If usage of a Section, such as Section IX,

involves exceptions, omissions, or changes in provisions, the intent of the Code might not be attained.

Where a state or other regulatory body, in the printing of any Section of the Boiler and Pressure Vessel Code, makes additions or omissions, it is recommended that such changes be clearly indicated.

The National Board of Boiler and Pressure Vessel Inspectors is composed of chief inspectors of states and municipalities in the United States and of provinces in the Dominion of Canada that have adopted the Boiler and Pressure Vessel Code. This Board, since its organization in 1919, has functioned to uniformly administer and enforce the rules of the Boiler and Pressure Vessel Code. The cooperation of that organization with the Boiler and Pressure Vessel Committee has been extremely helpful.

It should be pointed out that the state or municipality where the Boiler and Pressure Vessel Code has been made effective has definite jurisdiction over any particular installation. Inquiries dealing with problems of local character should be directed to the proper authority of such state or municipality. Such authority may, if there is any question or doubt as to the proper interpretation, refer the question to the Boiler and Pressure Vessel Committee.

The Specifications for materials given in Section II, Parts A and B, are identical with or similar to those of The American Society for Testing and Materials. When reference is made in an ASME Material Specification to an ASTM Specification for which a companion ASME Specification exists, the reference shall be interpreted as applying to the ASME Material Specification. The Specifications for welding materials given in Section II, Part C, are identical with or similar to those of the American Welding Society. Not all materials included in the ASME Material Specifications in Section II have been adopted for use in this Section. Usage is limited to those materials and grades listed in at least one of the Tables of Appendix I of this Section. All materials allowed by this Section and used for construction within the scope of these rules shall be furnished in accordance with the Material Specifications contained in Section II except where otherwise provided in Code Cases or in this Section of the Code. Material produced to an ASME or ASTM Material Specification is not limited as to country of origin.

When required by context in this Section, the singular shall be interpreted as the plural, and vice-versa; and the feminine, masculine, or neuter gender shall be treated as such other gender as appropriate.

STATEMENT OF POLICY ON THE USE OF CODE SYMBOLS AND CODE AUTHORIZATION IN ADVERTISING

ASME has established procedures to authorize qualified organizations to perform various activities in accordance with the requirements of the ASME Boiler and Pressure Vessel Code. It is the aim of the Society to provide recognition of organizations so authorized. An organization holding authorization to perform various activities in accordance with the requirements of the Code may state this capability in its advertising literature.

Organizations that are authorized to use Code Symbols for marking items or constructions which have been constructed and inspected in compliance with the ASME Boiler and Pressure Vessel Code are issued Certificates of Authorization. It is the aim of the Society to maintain the standing of the Code Symbols for the benefit of the users, the enforcement jurisdictions, and the holders of the symbols who comply with all requirements.

Based on these objectives, the following policy has been established on the usage in advertising of facsimiles of the symbols, Certificates of Authorization, and reference to Code construction. The American Society of Mechanical Engineers does not "approve," "certify," "rate," or "endorse" any item, construction, or activity and there shall be no statements or implications which might so indicate. An organization holding a Code Symbol and/or a Certificate of Authorization may state in advertising literature that items, constructions, or activities "are built (produced or performed) or activities conducted in accordance with the requirements of the ASME Boiler and Pressure Vessel Code," or "meet the requirements of the ASME Boiler and Pressure Vessel Code."

The ASME Symbol shall be used only for stamping and nameplates as specifically provided in the Code. However, facsimiles may be used for the purpose of fostering the use of such construction. Such usage may be by an association or a society, or by a holder of a Code Symbol who may also use the facsimile in advertising to show that clearly specified items will carry the symbol. General usage is permitted only when all of a manufacturer's items are constructed under the rules.

STATEMENT OF POLICY ON THE USE OF ASME MARKING TO IDENTIFY MANUFACTURED ITEMS

The ASME Boiler and Pressure Vessel Code provides rules for the construction of boilers, pressure vessels, and nuclear components. This includes requirements for materials, design, fabrication, examination, inspection, and stamping. Items constructed in accordance with all of the applicable rules of the Code are identified with the official Code Symbol Stamp described in the governing Section of the Code.

Markings such as "ASME," "ASME Standard," or any other marking including "ASME" or the various Code Symbols shall not be used on any item which is not constructed in accordance with all of the applicable requirements of the Code.

Items shall not be described on ASME Data Report Forms nor on similar forms referring to ASME which tend to imply that all Code requirements have been met when, in fact, they have not been. Data Report Forms covering items not fully complying with ASME requirements should not refer to ASME or they should clearly identify all exceptions to the ASME requirements.

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ORGANIZATION OF SECTION III

1. GENERAL

Section III consists of Division 1 and Division 2. Both Divisions are broken down into Subsections which are designated by capital letters preceded by the letter "N" for Division 1 and by the letter "C" for Division 2. The following nine books make up the two Divisions.

Subsection NCA — General Requirements for Division 1 and Division 2

Division 1
- Subsection NB — Class 1 Components
- Subsection NC — Class 2 Components
- Subsection ND — Class 3 Components
- Subsection NE — Class MC Components
- Subsection NF — Component Supports
- Subsection NG — Core Support Structures
- Appendices

Division 2 — Code for Concrete Reactor Vessels and Containments

The Division 2 book includes Subsection CB — Concrete Reactor Vessels, Subsection CC — Concrete Containments, and Division 2 Appendices.

2. SUBSECTIONS

Subsections are divided into Articles, Subarticles, paragraphs, and, where necessary, subparagraphs and subsubparagraphs.

3. ARTICLES

Articles are designated by the applicable letters indicated above for the Subsections followed by Arabic numbers, such as NB-1000 or CB-2000. Where possible, Articles dealing with the same topics are given the same number in each Subsection in accordance with the following general scheme:

Article Number	Title
1000	Introduction or Scope
2000	Material
3000	Design
4000	Fabrication and Installation
5000	Examination
6000	Testing
7000	Overpressure Protection
8000	Nameplates, Stamping, and Reports

The numbering of Articles and the material contained in the Articles may not, however, be consecutive. Due to the fact that the complete outline may cover phases not applicable to a particular Subsection or Article, the rules have been prepared with some gaps in the numbering.

4. SUBARTICLES

Subarticles are numbered in units of 100, such as NB-1100 or CB-1200.

5. SUBSUBARTICLES

Subsubarticles are numbered in units of 10, such as NB-2130, and generally have no text. When a number such as NB-1110 is followed by text, it is considered a paragraph.

6. PARAGRAPHS

Paragraphs are numbered in units of 1, such as NB-2131 or CB-2132.

7. SUBPARAGRAPHS

Subparagraphs, when they are *major* subdivisions of a paragraph, are designated by adding a decimal followed by one or more digits to the paragraph number, such as NB-1111.1 or CB-1111.2. When they are *minor* subdivisions of a paragraph, subparagraphs may be designated by lowercase letters in parentheses, such as NB-1111(a) or CB-1111(b).

8. SUBSUBPARAGRAPHS

Subsubparagraphs are designated by adding lowercase letters in parentheses to the *major* subparagraph numbers, such as NB-1111.1(a) or CB-1111.1(b). When further subdivisions of *minor* subparagraphs are necessary, subsubparagraphs are designated by adding Arabic numerals in parentheses to the subparagraph designation, such as NB-1111(a)(1) or CB-1111(a)(2).

9. REFERENCES

References used within Section III generally fall into one of the following four categories.

A. References to Other Portions of Section III

When a reference is made to another Article, Subarticle, or paragraph, all numbers subsidiary to that reference shall be included. For example, reference to NB-3000 includes all

material in Article NB-3000; reference to NB-3230 includes all paragraphs NB-3231 through NB-3236.

Wherever the term NX appears, it is intended to describe all the Subsections of Section III (NB, NC, ND, NE, NF, NG) where the referenced paragraph, Subarticle, or Article appears.

B. References to Other Sections

Other Sections referred to in Section III are:

Section II, Material Specifications. When a requirement for a material, or for the examination or testing of a material, is to be in accordance with a specification such as SA-105, SA-370, or SB-160, the reference is to material specifications in Section II. These references begin with the letter "S."

Section V, Nondestructive Examination. Section V references begin with the letter "T" and relate to the nondestructive examination of material or welds.

Section IX, Welding and Brazing Qualifications. Section IX references begin with the letter "Q" and relate to welding and brazing requirements.

Section XI, Rules for Inservice Inspection of Nuclear Power Plant Components. When a reference is made to inservice inspection, the rules of Section XI shall apply.

C. Reference to Specifications and Standards Other Than Published in Code Sections

(1) Specifications for examination methods and acceptance standards to be used in connection with them are published by the American Society for Testing and Materials. At the time of publication of Section III, some such specifications were not included in Section II of this Code. A reference to ASTM E 71-64 refers to the specification so designated by and published by ASTM, 1916 Race St., Philadelphia, PA 19103.

(2) Dimensional standards covering products such as valves, flanges, and fittings are sponsored and published by the American Society of Mechanical Engineers and approved by the American National Standards Institute.[1] When a product is to conform to such a standard, for example ANSI B16.5, the standard is approved by the American National Standards Institute. The applicable year of issue is that suffixed to its numerical designation in Table NB-3132-1, for example ANSI B16.5-1977. Standards published by the American Society of Mechanical Engineers are available from ASME, 22 Law Drive, Box 2300, Fairfield, NJ 07007-2300.

(3) Dimensional and other types of standards covering products such as valves, flanges, and fittings are also published by the Manufacturers Standardization Society of the Valve and Fittings Industry and are known as Standard Practices. When a product is required by these rules to conform to a Standard Practice, for example MSS SP-6, the Standard Practice referred to is published by the Manufacturers Standardization Society of the Valve and Fittings Industry, 1815 North Ft. Meyer Drive, Arlington, VA 22209. The applicable year of issue of such a Standard Practice is that suffixed to its numerical designation in Table NB-3132-1, for example MSS SP-6-1963.

(4) Specifications for welding and brazing materials are published by the American Welding Society, 2501 Northwest 7th St., Miami, FL 33125. Specifications of this type are incorporated in Section II and are identified by the AWS designation with the prefix "SF," for example SFA-5.1.

(5) Standards applicable to the design and construction of tanks and flanges are published by the American Petroleum Institute and have designations such as API-620 and API-2000. When documents so designated are referred to in Section III, they are standards published by the American Petroleum Institute.

D. References to Appendices

Two types of Appendices are used in Section III and are designated Mandatory and Nonmandatory.

(1) Mandatory Appendices contain requirements which must be followed in construction; such references are designated by a Roman numeral followed by Arabic numerals. References to Table I-1.2 or II-1100, for example, relate to the Mandatory Appendices.

(2) Nonmandatory Appendices provide information or guidance for the use of Section III; such references are designated by a capital letter followed by Arabic numerals. A reference to D-1100, for example, relates to a Nonmandatory Appendix.

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[1]The American National Standards Institute (ANSI) was formerly known as the American Standards Association. Standards approved by the Association were designated by the prefix "ASA" followed by the number of the standard and the year of publication. More recently, the American National Standards Institute was known as the United States of America Standards Institute. Standards were designated by the prefix "USAS" followed by the number of the standard and the year of publication. While the letters of the prefix have changed with the name of the organization, the numbers of the standards have remained unchanged.

THE AMERICAN CONCRETE INSTITUTE

The American Concrete Institute was organized in 1905 to provide industry standards in the field of concrete usage. The organization, which was formed as a result of meetings begun during the Engineering Congress at the Louisiana Purchase Exposition in St. Louis in 1904, was initially entitled the National Association of Cement Users. In 1913, the name of the Society was changed to the American Concrete Institute to better fit the actual scope of its activities and aims, which are to further engineering education, scientific investigation, and scientific research by organizing the efforts of its members for a nonprofit, public service in gathering, correlating, and disseminating information for the improvement of the design, construction, manufacture, use, and maintenance of concrete products and structures.

The day-to-day operation of ACI is administered by an Executive Director, under general supervision of its 18-member Board of Direction, which assigns a part of its administrative duties to standing committees, the ACI Standards Board, and various technical committees.

ACI — TECHNICAL ACTIVITIES COMMITTEE

The Technical Activities Committee, which is appointed by the Board of Direction, is responsible for Institute technical publications, review of standards, the technical program at conventions, and continuing studies of technical committees, from which arise recommendations for the activities, and the formation or discharge of these groups. TAC members are selected by the ACI Board to represent ACI's varied interests.

ACI — STANDARDS BOARD

The Standards Board, also appointed by the Board of Direction, is responsible for matters of policy, procedure, and appeal pertaining to ACI Standards. All proposed new standards or revisions to existing standards, including minority reports from sponsoring technical committees, are forwarded to the Standards Board through the Technical Activities Committee. On release by the Standards Board, these are published, and after ratification by letter ballot of the ACI membership at large are then available for public use. The primary functions of the Standards Board are to verify that proper standardization procedures have been followed and to rule on matters of policy as related to standards.

ACI — TECHNICAL AND EDUCATIONAL COMMITTEES

Much of the important work of the American Concrete Institute is performed by technical committees that prepare committee reports and standards. Technical committees, composed of volunteer personnel, develop ACI recommendations in their respective fields. Their work, subject to review and approval by the Board of Direction through the Technical Activities Committee and the Standards Board, forms the basis for Institute Standards.

Educational committees, also composed of volunteer personnel, develop seminars, workshops, curriculum guides, and student manuals to further ACI's involvement in education. Their work, subject to review and approval by the ACI Educational Activities Committee, forms the basis for Institute manuals and training programs.

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ARTICLE NCA-1000
SCOPE OF SECTION III

NCA-1100 SCOPE

NCA-1110 NATURE OF THESE RULES AND COMPONENTS TO WHICH THEY ARE APPLICABLE

The rules of this Section constitute requirements for the design, construction,[1,2] stamping, and overpressure protection of nuclear power plant[3] items[4] such as vessels, concrete reactor vessels and concrete containments, storage tanks, piping systems, pumps, valves, core support structures, and component supports for use in, or containment of, portions of the nuclear power system of any power plant.[5] A nuclear power system, as used in this Code, is that system which serves the purpose of producing and controlling an output of thermal energy from nuclear fuel and those associated systems essential to the functions and overall safety of the nuclear power system. The rules of this Section apply only to those items which are classified by the Owner as provided for in NCA-2110(d). All other equipment not so classed need not be constructed to this Section. The rules for inservice inspection of the items of the nuclear power system are covered in Section XI, and its rules may influence construction under this Section.

NCA-1120 DEFINITION OF NUCLEAR POWER SYSTEM ITEMS

(a) Nuclear power system items for which rules are specified by this Section are those items which are designed to provide a pressure containing barrier or are a pressure retaining member in the system and those designed as core support structures and component supports.

(b) Containment systems for which rules are specified by this Section are those items which form structures that enclose nuclear power systems or that may be connected to other containment items and which are designed to provide a pressure containing barrier for the primary purpose of containing, within leakage limits, or of channeling, for containment or for controlled disposal, radioactive or hazardous effluents released from the system. Containment structures may be constructed either to Subsection NE or Subsection CC of this Section.

(c) Concrete reactor vessels for which rules are specified by this Section are composite steel and concrete components which are to function as a component of the principal pressure containing barriers for the nuclear fuel's primary heat extraction fluid (primary coolant).

(d) Concrete containments are composite steel and concrete assemblies that are designed as an integral part of the containment's pressure retaining barrier which retain or control the release of radioactive or hazardous effluents released from the nuclear power plant equipment which the containment encloses.

NCA-1130 LIMITS OF THESE RULES

(a) The rules of this Section provide requirements for new construction and include consideration of mechanical and thermal stresses due to cyclic operation. They do not cover deterioration which may occur in service as a result of radiation effects, corrosion, erosion, or instability of the material. These effects shall be taken into account with a view to realizing the design or the specified life of the components. The changes in properties of materials subjected to neutron radiation can be checked periodically by means of material surveillance programs.

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[1]Construction (as used in Division 1).
[2]Construction (as used in Division 2).
[3]A nuclear power plant consists of one or more nuclear power systems and containment systems as well as other systems not covered by the rules of this Section.
[4]Items as used in this Section are products constructed under a Certificate of Authorization (NCA-3120) and material (NCA-1220).
[5]Specifically excluded from consideration in this Section are tubes or other forms of sheathing used only for cladding nuclear fuel or neutron control material.